REMARKS

This application has been reviewed in light of the Office Action dated June 3, 2004. Claims 1-5, 7, 8, and 10-24 are presented for examination, of which Claims 1, 10, 15, and 20, which are the independent claims, have been amended to define still more clearly what Applicants regard as their invention. Formulas in Claims 3, 4, 13, 17, 18, 22, and 23 have been amended to ensure consistency among corresponding claims. Favorable reconsideration is requested.

Applicants note with appreciation the continued indication that Claims 3, 4, 12, 13, 17, 18, 22, and 23 would be allowable if rewritten so as not to depend from a rejected claim, and with no change in scope. These claims have not been so rewritten because, for the reasons given below, their base claims are believed to be allowable.

The specification was objected to because of the informalities noted at page 2 of the Office Action. Applicants have amended the specification to overcome the noted objections. It is believed that the objection to the specification has been remedied, and its withdrawal is therefore respectfully requested.

Claims 1-5 and 7 were objected to because of an informality noted at page 3 of the Office Action.

Claim 1 has been amended to remove the phrase "cleansing process". Accordingly, the objection to Claim 1 has been overcome. Because Claims 2-5 and 7 depend on Claim 1, the objection to these claims has also been overcome. Accordingly, Applicants respectfully request the withdrawal of the objection to Claims 1-5 and 7.

Claims 1, 2, 5, 7, 10, 11, 14-16, 19-21 and 24[1] were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,008,752 (*Van Nostrand*) in view of U.S. Patent No. 5,054,100 (*Tai*).

As shown above, Applicants have amended independent Claims 1, 10, 15, and 20 in terms that still more clearly define what they regard as their invention. Applicants submit that these amended independent claims, together with the remaining claims dependent thereon, are patentably distinct from the cited prior art for at least the following reasons.

The aspect of the present invention set forth in Claim 1 is a method of interpolating a first set of discrete sample values to generate a second set of discrete sample values using one of a plurality of interpolation kernels. The method includes identifying text and edge regions in the first set of discrete sample values depending on an edge strength indicator, an edge direction indicator and a local contrast indicator for each of the discrete sample values of the first set. The text and edge regions are combined to form a kernel selection map and the kernel selection map is cleaned by re-orientating the edge regions according to an underlying edge direction. The interpolation kernel is selected using the cleaned kernel selection map for use in interpolating the first set of discrete sample values to generate the second set of discrete sample values.

Among other important features of Claim 1 is cleaning the kernel selection map by re-orientating the edge regions according to an underlying edge direction.

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[1]The Office Action at page 3 states that Claim 6 is rejected under 35 U.S.C. § 103(a). Claim 6 was canceled in the Amendment filed October 29, 2003, and will not be addressed herein.

As disclosed at page 9, lines 9-28 of the specification[2], high contrast text regions are detected, where both edge strength and edge orientation of the image data are measured. The detected text regions and edge regions are combined into a kernel, or kernel-parameter, selection map for each input pixel, and the kernel, or kernel-parameter, selection map is cleaned (Step 125 of Figure 1). As particularly described at page 9, lines 21-23, the cleaning process involves re-orientating edge regions to an underlying uniformly directed edge region or smooth background to produce a cleaned kernel selection map. The cleaned kernel selection map is at the input pixel resolution. The appropriate interpolation kernel, based on the output-resolution kernel selection map, is applied to the image data.

Further, as described at page 14, lines 3-6, in the cleaning of the kernel selection map process (Figure 5), the major and minor edge orientations are identified and minor edge pixels are reassigned to the major orientation in the following steps, with the exception of identified text region pixels (Step 520 of Figure 5).

As discussed previously, *Van Nostrand* describes an interpolator for enlarging or reducing a digital image. An interpolation coefficient memory contains interpolation coefficients representing several different one-dimensional interpolation kernels. A row interpolator receives image pixel values, retrieves interpolation coefficients from the memory and produces interpolated pixel values by interpolating in a row direction. A column interpolator receives multiple rows of interpolated pixel values from the row interpolator, retrieves interpolation coefficients from the memory, and produces rows of interpolated pixel values by

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[2]It is to be understood, of course, that the claim scope is not limited by the details of the described embodiments, which are referred to only to facilitate explanation.

interpolating in a column direction. A logic and control unit monitors the contents of the input data and switches between interpolation kernels to provide optimum interpolation for each type of content (see Abstract).

The preferred embodiment of *Van Nostrand* employs two interpolation kernels. A cubic convolution kernel is used for continuous tone images and a replication kernel is used for alphanumeric text (see col. 5, lines 46-57).

The Office Action concedes that *Van Nostrand* does not specify using an edge strength indicator and an edge direction indicator.

However, the Examiner contends that *Van Nostrand* discloses that the selection of the interpolation kernel is performed using a kernel selection map processed in accordance with a cleaning process such that the kernel selected for a particular discrete sample value of the first set is dependent on the kernel selected for a further discrete sample value adjacent to the particular discrete sample value, and cites column 15, lines 3-20, of *Van Nostrand* as support thereof.

Applicants understand column 15, lines 3-20, of *Van Nostrand* as discussing that where two interpolation kernels are employed (cubic convolution and replication) it will be understood that more than 2 kernels may be employed. *Van Nostrand* discusses that a number of cubic convolution kernels providing different degrees of edge enhancement may be employed, and the switch made between cubic convolution kernels when edges are detected, thereby providing selective edge enhancement in the interpolated images. *Van Nostrand* also discusses, at column 15, lines 15-17, that cubic convolution kernels providing edge suppression can be employed with a detector for detecting low amplitude high frequency detail such as film grain in

a digitized photograph. The edge suppressing kernel is selected in response to detecting such detail, thereby providing film grain suppression in the interpolated image.

However, Applicants submit that nothing has been found in *Van Nostrand* that would teach or suggest the feature of cleaning the kernel selection map by re-orientating the edge regions according to an underlying edge direction, as recited in Claim 1. As discussed above and as described at page 9, lines 20-23, of the specification, the cleaning process involves re-orientating edge regions to an underlying uniformly directed edge region or smooth background to produce a cleaned kernel selection map. This particular claimed feature avoids excessive kernel switching which may result in visual artefacts in the interpolated image.

While no cleaning of a kernel selection map is taught or suggested by *Van Nostrand*, Applicants have amended Claim 1 to more clearly define the invention and the nature of the cleaning process.

The Examiner contends that it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the selection of interpolation kernels disclosed by *Van Nostrand* to include selecting the interpolation kernels depending on an edge strength indicator and an edge direction indicator as taught by *Tai*.

Applicants submit that *Tai* does not overcome the deficiencies of *Van Nostrand.*

Tai relates to a pixel interpolator with edge sharpening. A quadratic interpolation equation is used-to-apply location weighting factors to the density values of neighboring pixels. Edge strength modifying factors are used to modify the weighting factors in the X, Y and diagonal directions. In one embodiment, the modifying factors are set to greater

than unity when the corresponding edge strength is greater than a predetermined threshold value. In another embodiment, the modifying factors are a non-linear function of the edge -strength (see Abstract). *Tai* describes the modification of a single interpolation equation.

Applicants submit that neither *Tai* nor *Van Nostrand*, nor any proper or permissible combination would teach or suggest the feature of cleaning the kernel selection map by re-orientating the edge regions according to an underlying edge direction, as recited in Claim 1.

Applicants understand that a combination of *Van Nostrand* and *Tai* (assuming *arguendo* that any such a combination would even be permissible) would teach a method for performing interpolation on an input digital image signal having pixel values representing rows and columns of pixels, to produce an interpolated digital image that has more or fewer pixels. The method may employ a number of cubic convolution kernels providing different degrees of edge enhancement. The method may switch between cubic convolution kernels when edges are detected. The method may also use cubic convolution kernels to provide edge suppression with a detector for detecting low amplitude high frequency detail such as film grain in a digitised photograph. The method may select the cubic convolution kernel for performing interpolation. Cubic convolution kernels may be selected based on transitions between intensity levels in an image. Cubic convolution kernels may also be selected based on edge strength and edge direction. However, Applicants submit that a combination of *Van Nostrand* and *Tai* would not teach or suggest cleaning the kernel selection map by re-orientating the edge regions according to an underlying edge direction, as recited in Claim 1.

Accordingly, *Van Norstrand* and *Tai*, alone or in any proper and permissible combination, are not seen to disclose or suggest the method as defined by independent Claim 1, and Claim 1 is believed clearly allowable over *Van Norstrand* and *Tai*, whether taken separately or in any proper combination.

Independent Claims 15 and 20 are apparatus, and computer readable medium claims, respectively, corresponding to method Claim 1, and Claim 10 is to a method claim similar to that of Claim 1; these three claims are believed to be patentable for at least the same reasons as those discussed above in connection with Claim 1.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

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